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1248891

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DRAWINGS ATTACHED

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(54) PRESS MOULD FOR VULCANISATION OF VEHICLE TYRES

(71) We, ADOLF HERBERT of Briandring 37, D-6 Frankfurt am Main, Germany, and MARTHA GUHR of Scheidstrasse 2, D-6 Frankfurt am Main, Germany, both German Citizens, trading as LEONHARD HERBERT MASCHINENFABRIK, a German K.G., of D-6, Bergen-Enkheim, Frankfurter Strasse 40 Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement: —

This invention relates to a moulding press for the vulcanisation of tyres and which includes co-axial upper and lower mould parts movable axially relative one to the other from an open condition of the mould in which a tyre can be placed into or removed from the mould and a fully closed condition of the mould in which radially movable segments effect moulding of the running surfaces of a tyre tread. The segments when the moulding parts are in the closed position, can be shifted radially by way of a moving mechanism having a ring encircling the segments, said mechanism being located on the mould and becoming effective by the closing movement of the press.

Moulds of this kind have been developed for the production of radial tyres. In the case of production of radial tyres it is important that the belt or ply does not change its position relative to the remainder of the tyre during the closing of the mould. This can be achieved best with the above mentioned moulds, since in that case, the side walls are placed into their final position before any of the segments engage the periphery of the tyre, which could cause an axial shift of the belt or ply.

The radial stroke of the segments depend for one thing on the depth of the tread design and, secondly, on the manner in which the segments encircle the tyre, that is to say the extent by which the parts of the segments lying closest to the median plane of the tyre are spaced therefrom. The encirclement by the peripheral segments depends on the formation of the tread design and in many instances it reaches up into the area of the side walls of the tyres. Having a minimum mould diameter in view, it is desirable for the radial stroke of the segments to be kept as short as possible.

In a known mould of the kind described in British Patent Specification No. 1,039,049, the segments each consist of one piece and are held on the upper part of the mould. The segments are driven by reason of the fact that during the closing of the mould a sloping surface is displaced relative to the segments. This displacement is possible because the sloping surface is arranged on a plate which is displaceable against the force of a spring relative to the remaining upper part of the mould. The attachment of the segments to the upper mould part has the advantage that the tyre is widely exposed after opening of the mould. Also, cleaning of the lower parts of the mould, for example by blowing out with compressed air, is considerably facilitated since the segments are not in the that way. However, there is the disadvantage that a relatively large radial stroke of the segments is necessary if the encirclement of the tyre by the segments is relatively far reaching.

A mould is also proposed in German Patent Specification No. 1,160,606 in which the segments are divided in a plane located between the two mould parts. In this proposal each of the complementary parts of the segments is provided with its own separate driving arrangement for effecting radial insertion thereof. In the opened position of the press, the parts of the segments are raised for a relatively considerable distance above the surfaces forming the side walls of the tyre. In the case of the known mould, the approach of the parts forming the side walls and of the peripheral segments to the tyre takes place simultaneously.

The present invention has for an object thereof to provide a mould the diameter of which can be kept as small as possible while having a segment actuating mechanism which is relatively simple.

According to the invention a moulding press for vulcanising tyres comprises co-axial upper and lower mould parts movable axially relative on to the other from an open condition of the mould in which a tyre can be placed into or removed from the mould and a fully closed condition of the mould in which a tyre is enclosed therein for moulding and vulcanising, first and second sets of moulding segments carried respectively by the upper and lower mould parts and arranged for radial displacement relative thereto, each segment of the first set being complementary to a segment of the second set to form therewith a unitary segment in the fully closed condition of the mould, coupling means operable in the closed condition of the mould to couple the segments of the first and second sets for simultaneous radial movement thereof, and actuating mechanism associated with one of the mould parts and operable on axial movement of said one mould part relative to the other mould part to effect radial displacement of the coupled segments.

In the case of a press in accordance with the invention, it is sufficient to retract the segments by only a little more than the depth of the tread design in order to release the tyre in such a way that the upper part of the mould can dissociate from the tyre and that later on the tyre can be lifted out of the lower mould part. Despite this advantage, the actuating mechanism is not more complicated than in the case of a mould where the segments are not divided. On the contrary, because of the shorter radial stroke they are even more simple insofar as constructional difficulties which result in the case of long strokes no longer exist. Despite the division of the segments, it is sufficient to have one actuating mechanism which is attached to one mould part since the complementary parts of the segments can be coupled with one another to effect radial movements thereof. Also, the advantage has been retained, that prior to the radial inward movement of the segments, the mould has come into contact with the side walls of the tyre.

The parts of the segments which are moved radially by engagement thereof with their complementary parts are advantageously carried by the lower mould part and the said complementary parts of the segment are carried by the upper mould part. Thus when the mould is opened the set of segments carried by the lower mould part project upwards only to the extent of their height above a base by which they are carried and because of this they do not need to be displaced axially and no axial stroke therefor is added to the height of the apparatus. The cleaning of the lower half of the mould by blowing out, is thus still possible relatively easily.

In preferred embodiments of the invention the segments co-operate with sloping faces which are displaceable by impulsion units relative to the segments when the mould parts are in the fully closed condition thereof. Naturally however, other forms of actuating mechanisms can also be used, for example, mechanisms which operate with articulated links which press the segments into the moulding positions thereof.

In the case of the mould described in the above-mentioned British Patent Specification No. 1,039,049 springs are used as impulsion units. In the case of larger moulds because of the large forces which are required to hold down the upper side wall of the tyre when the tyre is under pressure, numerous and also strong springs are needed, the housing of which is constructionally possible but sometimes causes difficulties. To overcome these difficulties, it is proposed in a preferred embodiment of the present invention to use an actuating mechanism consisting of a fluid pressure cylinder, which in the preferred form thereof is a double-acting cylinder. With the aid of such an arrangement large forces can be exerted on the upper mould portion which suffice to hold, even in the case of large moulds, the upper mould portion in its closed position relative to the lower mould portion before radial inward movement of the segments to the moulding positions thereof. A double acting cylinder has the further advantage, as compared to the use of springs, that in the case of the opened position of the press the upper mould part can be drawn against the upper part of the press, as a result of which for one thing, one will achieve a contact with a heating plate, when used, and for another, the axial retraction of the segments carried by the upper mould part. As a result thereof, a heating of the upper half of the mould can be achieved even in the open condition of the mould and the spacing between the upper and lower mould parts is such as greatly to facilitate the pivotal insertion of tyre feeding mechanism between the mould parts.

In another form of the fluid pressure cylinder arrangement, the operating space of the fluid pressure cylinder which is drained during the radial insertion of the segments can be drained by means of an over pressure valve whose opening force is so chosen as to be slightly greater than that of the force needed to press down the side walls of a tyre.

With a fluid pressure cylinder of the above-mentioned kind, one can achieve the same effect as with springs against the force of which the sloping faces are displaceable. The arrangement of an over pressure valve in the discharge line renders it possible to build

up a higher pressure in the fluid pressure cylinder than that obtainable only from a source of pressurised fluid. Accordingly, it is possible to exert large forces on the side walls of a tyre during the radial insertion of the segments even with relatively small effective surfaces of a fluid pressure cylinder.

In a particularly advantageous embodiment of the invention, a locating device is provided which retains the segments carried by the above-mentioned other of the mould parts in the radially retracted positions thereof. Such a locating device has the advantage that the segments maintain their retracted positions even if the segments receive knocks, for example, as a result of manipulation of the mould.

The locating device may comprise an arresting pin carried by said other of the mould parts and a release pin carried by a segment for axial movement into and out of the recess in the segment, said arresting pin being spring-urged for axial movement with and by the release pin.

The coupling means may comprise complementary wedge-shaped recesses and projections formed in opposing faces of the segments of the first and second sets of segments whereby during closing of the mould parts the segments are coupled and during operation of the actuating means the segments are first moved radially simultaneously to the moulding positions thereof and preparatory to opening of the mould are moved radially simultaneously to the retracted positions thereof.

In order that the invention may be fully understood, further objects of the invention will be apparent from the following description when considered in connection with the accompanying drawings, in which:—

Fig. 1 is a cross-section through a mould for a press according to the invention with the mould in its opened state,

Fig. 2 is a cross-section similar to Fig. 1, whereby the upper parts of segments associated with the mould have been moved radially outwardly,

Fig. 3 is a cross-section of the mould in a position in which the mould elements forming the side walls have already assumed their final position,

Fig. 4 is a cross-section of the mould in a completely closed position, and

Fig. 5 is a view, to an enlarged scale and in greater detail of the part V, Fig. 4, enclosed in a dash-dot line.

Referring to the drawings, the mould consists of a lower part 1 and an upper part 2. These parts 1 and 2 are surrounded by a steam dome which has a lower cylindrical-shaped part 3 and an upper bell-shaped part 4. To the lower cylindrical-shaped part 3, a connecting sleeve or nipple 65 is attached for a supply of superheated steam. Instead of a steam dome one can also use heating plates on which the moulding elements rest. In the case of use of heating plates also one can retain a dome, which then serves as an insulating bell.

In use the mould is built into a tyre vulcanising press, the lower part 1 of the mould being attached to a fixed press table and the upper part 2 being secured to a press element which can be lifted or lowered in relation to the table. The parts 1 and 2 of the mould will be described below in greater detail.

The mould part 1 has a base 5, Fig. 5, which has a bottom side 6 which rests on radially arranged ribs 7 welded on the bottom plate 8 of the lower part 3 of the steam dome. The ribs 7 make it possible to apply heated steam to the bottom side 6 of the mould. The base 5 is provided an annular concave surface 9 by means of which one side wall of a tyre is formed or moulded. The base 5 has secured thereto a set, referred to below as a "second set" of segments 10 which are radially displaceable. The nature and manner of attachment of the segments can best be seen from the more detailed drawing of Fig. 5.

The segments 10 each include a portion 11, Fig. 5, to which a moulding cup or shell 12 is attached by means of screws 13, for which purpose each shell 12 has a flange 14. The lower end of each moulding shell is engaged with a corner 15 of the portion 11. The active sides of the moulding shells 12 are provided with bridges 16 which during the moulding of a tyre are impressed into the still soft rubber and thereby form the grooves of the tread.

On the underside of the body 11, there is a groove 17 which is of T-shaped cross section. A T-shaped element 18 is engaged in the groove 17 and is secured to the base 5 by screws 19 and 20. It is clear that by the engagement of the T-shaped element 18 in the T-shaped groove 17, the segment 10 is guided in a radial direction as well as being arrested in an upward direction in such a way that it cannot be lifted off.

In the T-shaped element 18 there is a bore 21 in which an arresting pin 22 is displaceably mounted. The arresting pin 22 has a collar 23, which can abut a shoulder 24 of the bore 21. A spring 25 extends between the shoulder 24 and a grub-screw 26 which closes a bore 27 located in the base 5 and is arranged in extension of the bore 21.

A release pin 28 is slidable in a bore 29 provided in the body 11. The bore 29 is recessed and has a shoulder 30 against which a shoulder 31 on the release pin 28 may abut. The lower end of the bore 29 is lined with a bush 32 the edge 33 of which is chamfered.

On the top side of the body 11, there is a wedge-shaped recess 34 which has two flanks or wedge-shaped surface 35 and 36 and a bottom 37. As can be seen from the drawing

the bore 29 leads to the bottom 37 of the wedge-shaped recess 34.

From Fig. 5, it can also be seen that a centering pin 38 is provided in the base 5 of the lower part 1 of the mould, which pin 38 projects beyond the top side of the base 5 and is engaged in a recess 39 in the body 11. The pin 38 locates the segment 10 in the correct position thereof.

As can be seen from Fig. 1, the lower part 1 of the mould is provided with a ring 40 which serves as a tyre rim seat. The ring 40 is not shown in the enlarged drawing according to Fig. 5.

The upper part 2 of the mould, see Fig. 1, includes a support 41 on which a first set of segments 42, complementary to the segments 10 of the second set above referred to, are secured. The upper part of the mould also includes a ring 43 provided with a sloping surface 44 by means of which the upper segments 42 are displaced.

The ring 43 is screwed to a plate 45 which is a component part of the press and which is movable relative to the press table. The support 41, together with the parts carried thereby, is displaceable in an axial direction relative to the plate 45.

The support 41 and the plate 45 are connected with one to the other by a cylinder-piston arrangement designated generally by 46. A double-acting piston 47 is secured to the support 41 by attaching flanges 48 and 49. The piston 47 has a head 50, on which there are sealing rings 51 and 52 of U-shaped cross-section. The sealing ring 51 has a sealing action when the upper operating space 53 is pressurised, and the sealing ring 52 has a sealing action when the lower operating space 54 is pressurised. The piston 47 is displaceable in a cylinder 55 which is attached to a part 57 connected firmly with the plate 45 by means of an attaching flange 56. The cylinder 55 is closed at the top thereof by a cover 58, and at the lower end of the cylinder there is a piston guide ring 59, through which the piston shaft 60 passes in a pressure-tight manner. A sealing element 61 effects the seal between the shaft 60 and the guide ring 59.

The part 57 is attached to the cross-head of the press, not shown, and has an outside thread. Between the part 57 and a tubular extension of the plate 45, there is a rotatable intermediate bush 85 which has external and internal threads so that it is engaged with the part 57 and also with the plate 45. Rotation of the bush 85 permits the position of the plate 45 to be adjusted axially of the bush 85.

A pressure fluid inflow and outflow pipe 62, which includes an over-pressure valve 63, opens into the interior 53 of the cylinder 55. A pressure agent pipe 64 leads into the operating space 54.

The attachment of the upper peripheral segments 42 is best seen from Fig. 5. Each upper segment 42 has a portion 66 to the inner side of which a mould shell 67 is attached by screws 68 which penetrate a flange 69 on the shell 67 and which are screwed into the portion 66. The mould shells 67 are also provided with bridges 15 for the moulding of tyre grooves.

On the outside of the portion 66 there is a guide groove 70 in which a guide piece 71 is engaged. The guide piece 71 is dove-tailed in cross-section and is held firmly to the ring 43 by means of screws 72, 73 and 74. For an exact positioning of the guide piece 71 there is provided a key 75 which is engaged in a groove cut in the ring 43. Laterally to the groove 70, there are surfaces on the portion 66 which bear against the sloping surface 44 of the ring 43. To the top side of the portion 66, T-shaped part 76 is secured by means of a screw 77. The T-shaped part 76 is engaged in a T-shaped groove 78 which is located on the underside of the support 41 of the upper part 2 of the mould. The engagement of the T-shaped part 76 with the T-shaped groove 78 prevents the dropping off of the upper segment 42.

A narrow flange 79 is provided on the support 41 and abuts a narrow flange 80 when the ring 43 is lifted by the distance x, Fig. 5, in relation to the support 41.

On the underside of the body 66 there is a wedge-shaped projection 81, the cross-section of which is matched precisely to the cross-section of the recess 34 in the body 11, so that the projection 81 can be engaged positively within the recess 34 and form therewith coupling means by which the first and second sets of moulding segments are coupled for simultaneous radial movement thereof.

A centering pin 86, which has been drawn in broken line on the level of the recess 34, Fig. 5, has the purpose of centering a lower segment in relation to a co-operating upper segment, or vice-versa. In the projection 81 of the upper segment, there is a semi-circular recess corresponding to the centering pin 86 which is produced by clamping together the two segment halves and then dripping a hole. Corresponding to the centering pin 38, there is a centering pin per segment also attached to the upper part. All three centering pins are necessary because the guide grooves 17, 70 and 78 must have some lateral play and this play must be eliminated when the mould is closed so that the pattern on the shoulder of the tyre of which a part is on the tread segment and the other part on the lower or upper mould shell, will coincide.

The operation of the mould is as follows: —

When the press is opened, the mould parts assume the position shown in Fig. 1. In this position the segments 10 of the lower mould

part are pushed radially outward and are held in this pushed-out position by the engagement of the arresting pins 22 with the bores 29. The upper mould part 2 is lifted off the lower mould part 1. The segments 42 of the first set are in their radially retracted position and are maintained in this position by keeping the operating space 54 below the piston 47 under pressure. As a result thereof, the support 41 is drawn toward the plate 45 which is located on the movable part of the press. The segments 42 are held in their retracted position by the sloping surfaces 44 on the ring 43. This retraction of the segments in the opened position of the press has the advantage that more space is created for the pivotal insertion of a feed mechanism, and the upper mould part, when a heating plate is used, can be drawn against the heating plate so that in the opened position of the press also the upper mould part will be well heated.

Prior to closing of the mould after insertion of a tyre blank that is to be vulcanised, first of all the upper mould part 2 is placed in the position shown in Fig. 2. In order to achieve this position, starting from the position according to Fig. 1, the pressure fluid present in the operating space 54 is conducted away by means of the pipe 64 and pressure fluid is fed in by means of the pressure agent pipe 62. It is clear that as a result thereof, the support 41, with the parts carried thereby, is pressed downwards in relation to the plate 45. As a result of this downward pressing, the segments 42 slide along the sloping surface 44 and are pressed radially outward.

In the fully extended position, the flange 79 of the body abuts the flange 80 of the ring 43. As a result thereof, the extended position has been precisely defined. The projections 81 now are precisely perependicular above the wedge-shaped recesses 34.

Starting from the position according to Fig. 2, the movable part of the press is now lowered until the support 41 of the upper mould part 2 has arrived at its final position. During the downward movement of the upper mould part 2, the projections 81 are engaged with the aligned recesses 34 of the lower segment parts and the uppermost faces of the segments 10, which are normal to the axis of the mould, are engaged with faces of the segments 42, also normal to the axis of the mould, in the medial plane of the tyre located in the mould, Figs. 3 to 5. As can be seen from Fig. 5, the release pin 28 is pressed downward and the arresting pin 22 is forced out of the arresting bore 29. During the initial part of the closing operation of the press, the over-pressure valve 63 operates, that is to say, a pressure is maintained in the operating space 53 which corresponds to the opening pressure of the valve 63. This opening pressure is so selected that the internal pressure in the tyre is not capable of lifting the support 41 relative to the plate 45.

During the continued operation of the press, the plate 45 is pressed downwards with great force by means of the closing mechanism of the press whereby the opening pressure of the valve 63 is exceeded in the operating space 53. As a result thereof, the pressure medium is squeezed out of the operating space 53 and the plate 45 can be lowered until it makes contact with the support 41. The pressure ring 43 is also driven downwards, and as a result it moves in relation to the upper segments 42. The upper segments are thus pushed radially inward until they assume the position shown in Fig. 4, in which position the mould is closed and the upper segments are coupled to the lower segments by engagement of the projections 81 in the recesses 34. Because of the coupling of the upper segments 42 with the lower segments 10, the lower segments 10 are also driven radially inward, which mode is possible because the arresting pins have already previously been released. Now the press is completely closed. In the closed position, the two parts 3 and 4 are also fitted against each other, Fig. 4, so that now superheated steam can be fed in by means of the connecting sleeve or nipple 65.

After the tyre has been vulcanised, opening is accomplished in the reverse order from the closing method just described, that is to say, first of all the plate 45 is lifted by the application of pressure in the space 53 so that whereby the segments 10 and 42 are moved radially outward and the arresting pins 22 are re-engaged with the arresting bores 29. Now the plate 45 is lifted further whereby the support 41 is released from the top side of the tyre. Finally the tyre is lifted out from the lower mould half 2 by means of a tyre ejector.

From Fig. 5, it will be understood that for the radial opening stroke of the segments 10 and 42, a path will suffice which is only a little larger or longer than the depth T of the bridges 16, that is to say irrespective of the extent of the lateral enflanking of the tyre by the shells 12 and 67. For a given angle of slope of the face 44, the small distance T results in a minimum stroke x so that the overall size of the mould can be kept small. As a result thereof, it is possible to use the mould according to the invention in presses of kinds which were not originally intended for the reception of moulds with radially movable segments.

WHAT WE CLAIM IS:—

1. A moulding press for vulcanising tyres, comprising co-axial upper and lower mould parts movable axially relative one to the other from an open condition of the mould

in which a tyre can be placed into or removed from the mould and a fully closed condition of the mould in which a tyre is enclosed therein for moulding and vulcanising, first and second sets of moulding segments carried respectively by the upper and lower mould parts and arranged for radial displacement relative thereto, each segment of the first set being complementary to a segment of the second set to form therewith a unitary segment in the fully closed condition of the mould, coupling means operable in the closed condition of the mould to couple the segments of the first and second sets for simultaneous radial movement thereof, and actuating mechanism associated with one of the mould parts and operable on axial movement of said one mould part relative to the other mould part to effect radial displacement of the coupled segments.

2. A moulding press according to Claim 1, wherein the segments of the first and second sets have faces which in the fully closed condition of the mould engage each other substantially in the medial plane of a tyre located in the mould.

3. A moulding press according to Claim 1 or Claim 2, wherein the coupling means comprises complementary wedge-shaped recesses and projections formed in opposing faces of the segments of the first and second sets of segments whereby during closing of the mould parts the segments are coupled and during operation of the actuating means the segments are first moved radially simultaneously to the moulding positions thereof and preparatory to opening of the mould are moved radially simultaneously to the retracted positions thereof.

4. A moulding press according to any one of Claims 1 to 3, including locating means operable to locate the segments carried by said other mould part in the radially retracted positions thereof.

5. A moulding press according to Claims 3 and 4, wherein the locating devices are releasable by movement of the projections into said recesses.

6. A moulding press according to Claim 5, wherein each locating device comprises an arresting pin carried by said other of the mould parts and a release pin carried by a segment for axial movement into and out of the recess in the segment, said arresting pin being spring-urged for axial movement with and by the release pin.

7. A moulding press according to any one of Claims 1 to 6, wherein the actuating mechanism includes a ring carried by said one mould part, said ring being movable axially relative to said one mould part and having a sloping surface engaging the segments of the first set carried by said one mould part and arranged by axial movement relative to said one mould part to effect said radial movements of the segments of the first and second sets thereof.

8. A moulding press according to Claim 7, wherein axial movements of the ring are effected by an impulsion unit carried by said one mould part.

9. A moulding press according to Claim 8, wherein the impulsion unit comprises a fluid pressure cylinder.

10. A moulding press according to Claim 9, wherein the fluid pressure cylinder is double-acting.

11. A moulding press according to Claim 10, wherein the operating space of the cylinder is arranged to be drained during radial retraction of the segments of the first set and is connected with a source of fluid by a pipe including an over-pressure valve the opening forces of which is so selected as to be slightly greater than that of the force needed to press down the side walls of a tyre.

12. A moulding press according to any one of Claims 1 to 11, wherein the actuating mechanism is associated with the upper mould part.

13. A moulding press for the vulcanising of tyres constructed and arranged to operate substantially as herein described with reference to the accompanying drawings.

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1248891 COMPLETE SPECIFICATION

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Sheet 1

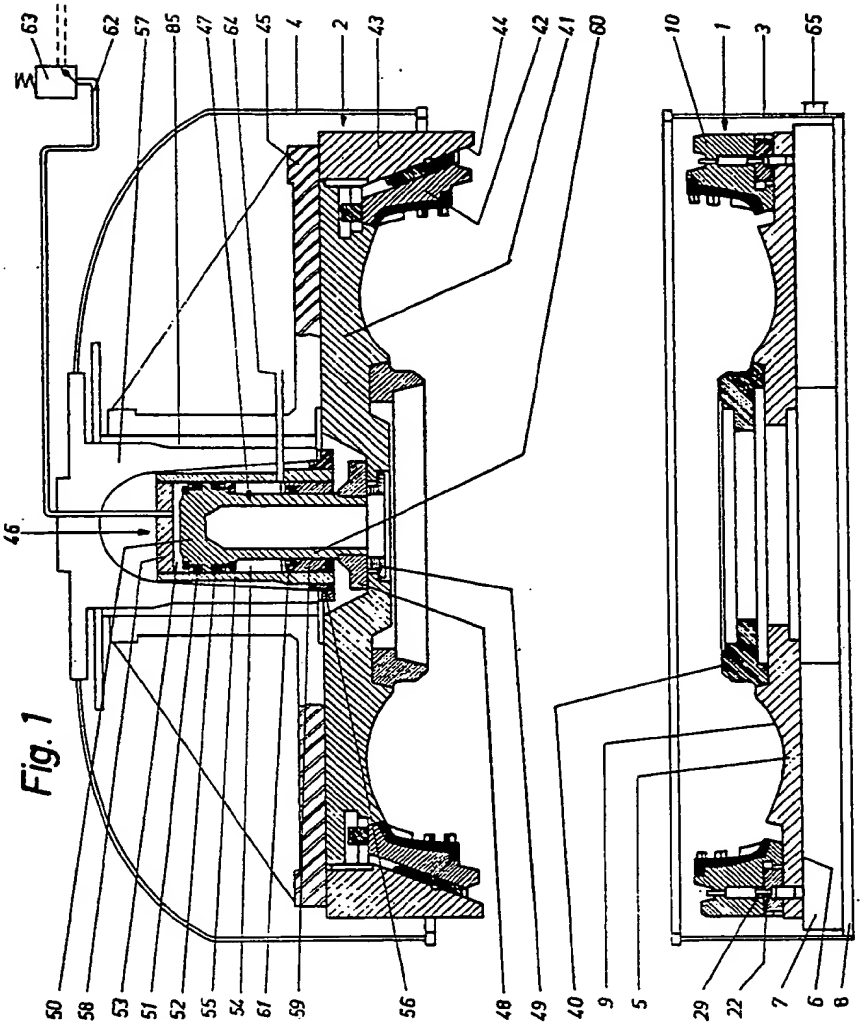

Fig. 1

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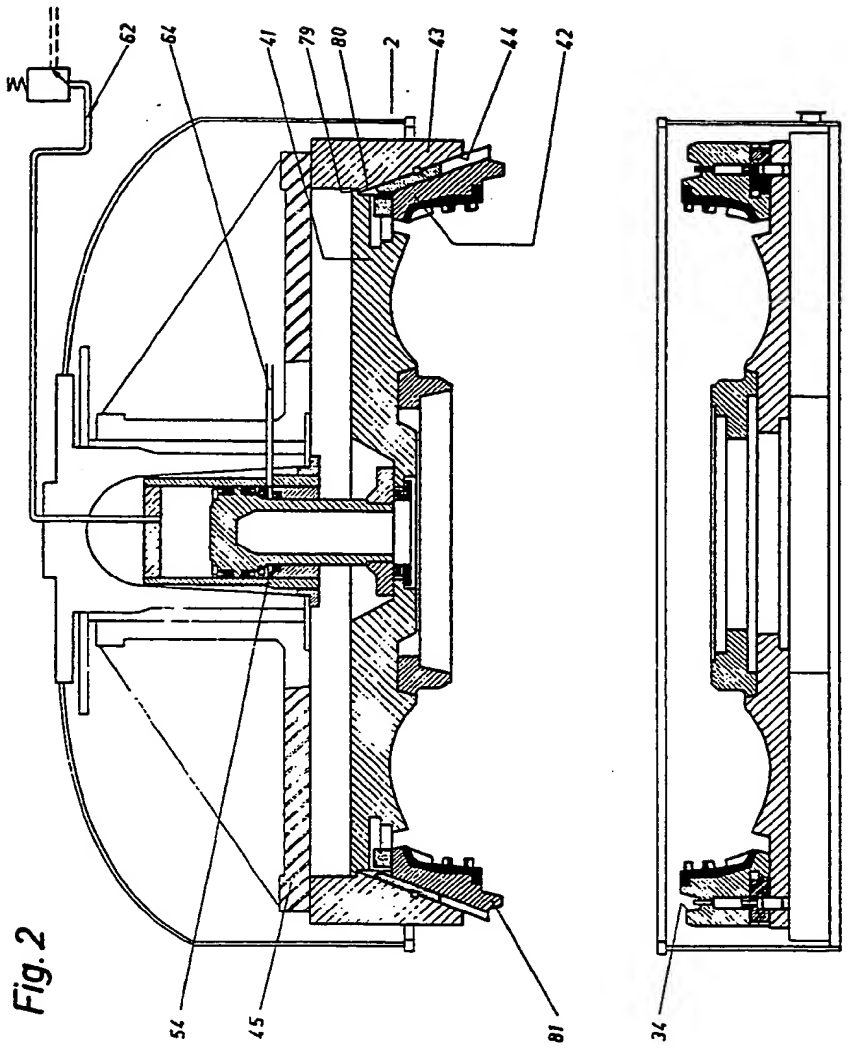

Fig. 2

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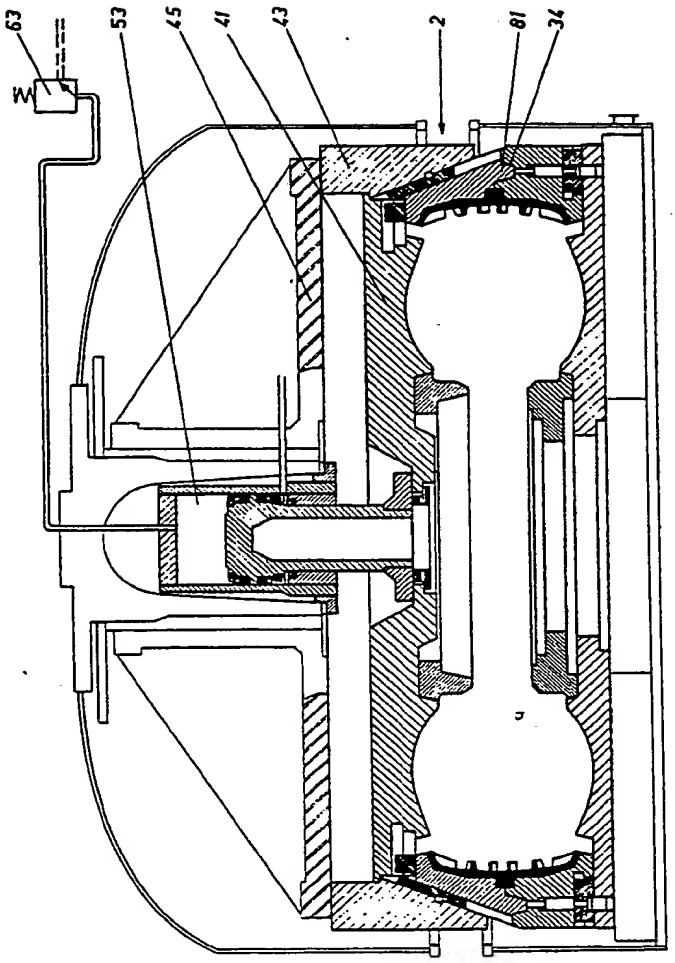

Fig. 3

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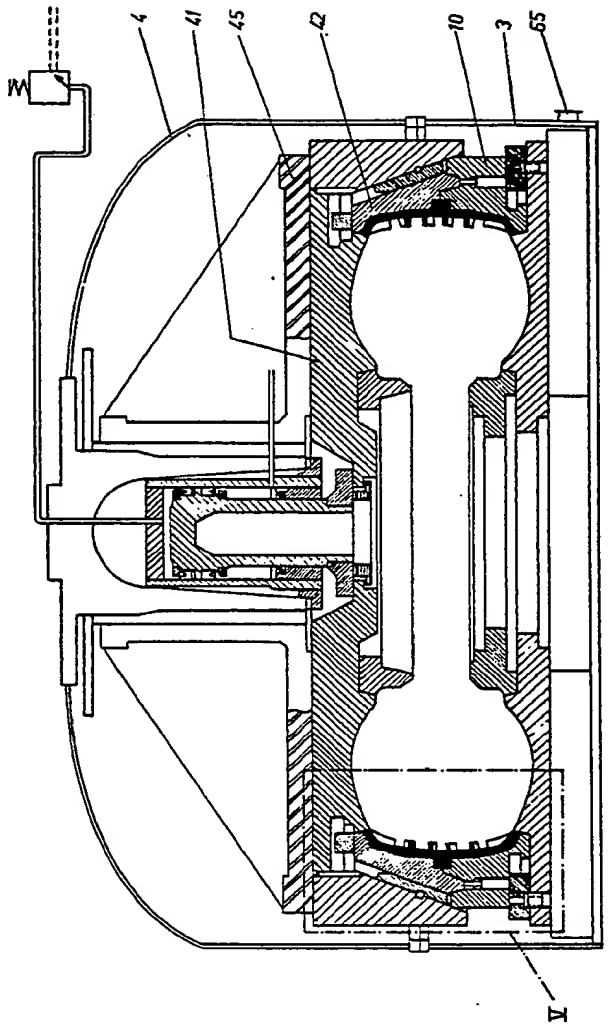

Fig. 4

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Sheet 5

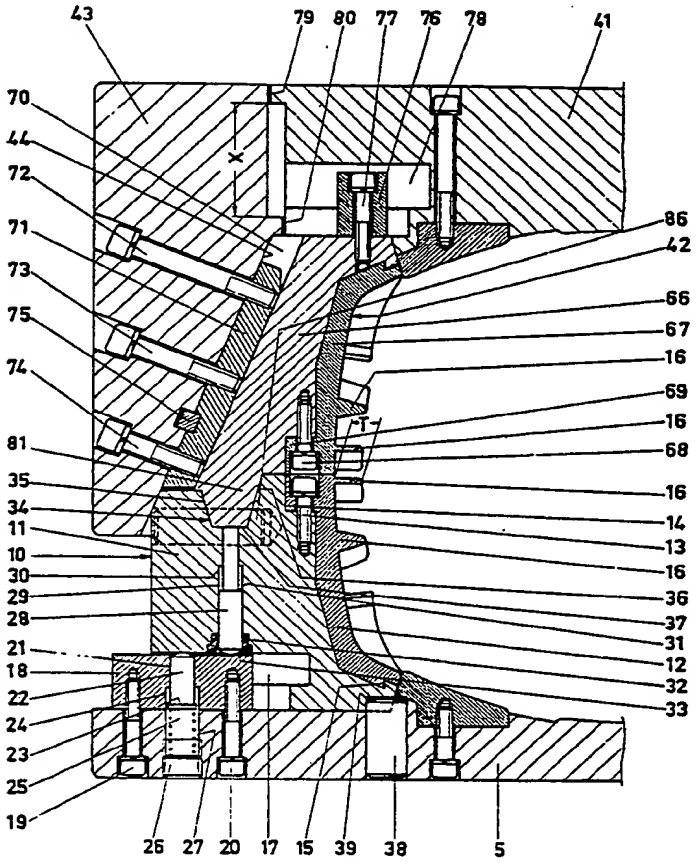

Fig. 5